Sounding Selection V 2.9 Case Study & Implementation

Lukas Mandrake

Jet Propulsion Laboratory, California Institute of Technology.

Dataset

Did not use CHI2 filter

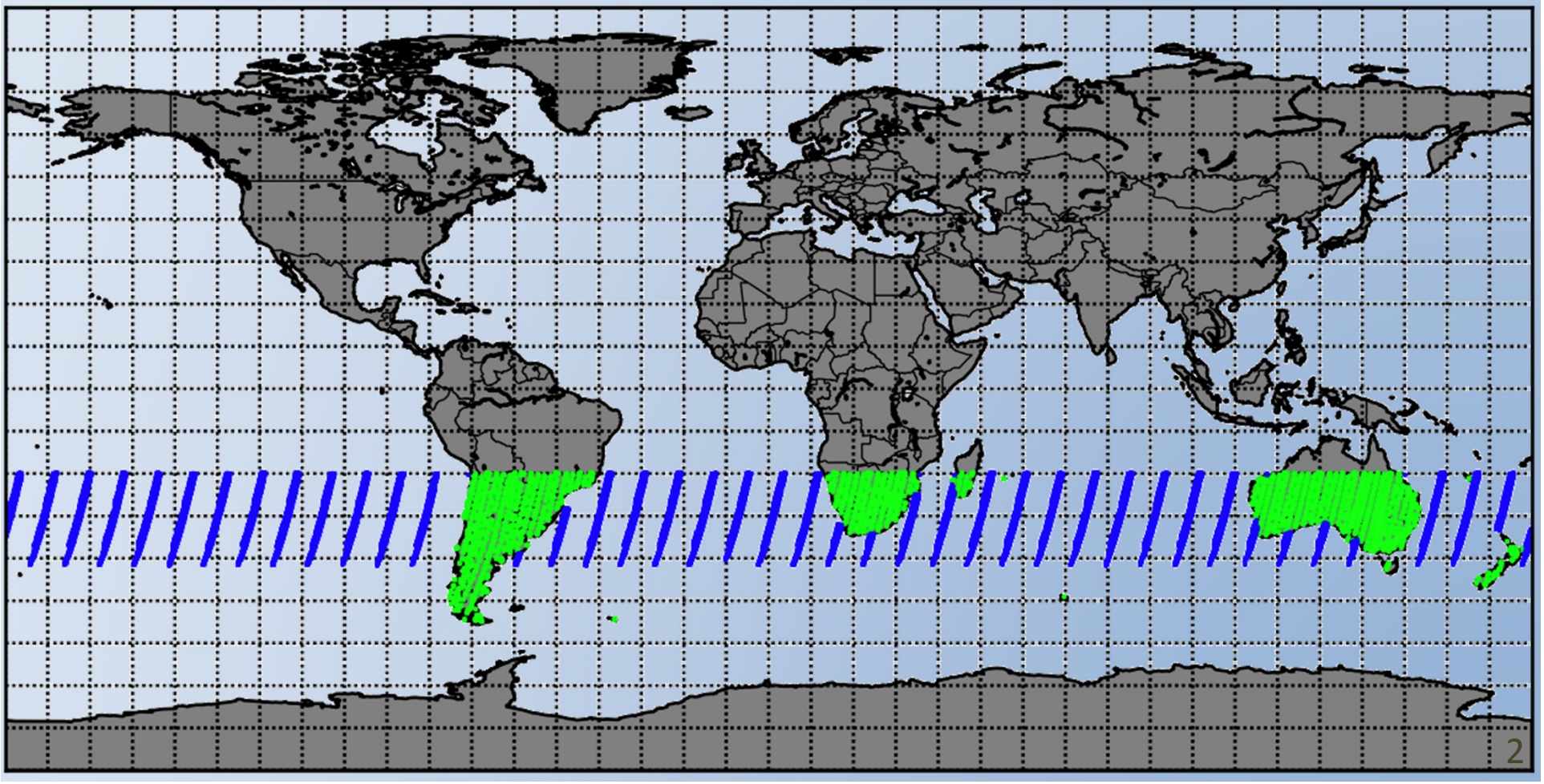
Settings:

Unfiltered: Got rid of NaN's, Inf's only
Did not use v130130
Lat Range: (-20 , -60)

Yields:

66,787 land
55,983 glint

Cloudy No Longer Processed



Requirements for Making Selector

1) Data (talk about how much later)

- Glint & Land data may be different

2) Goal to minimize

- Mean Monthly Standard Deviation (for southern Hem)

3) Genetic Algorithm to find filtering rules

- Can request how many rules you'll tolerate
- Fewer rules are simpler to interpret & more general
- More rules perform better on a given dataset

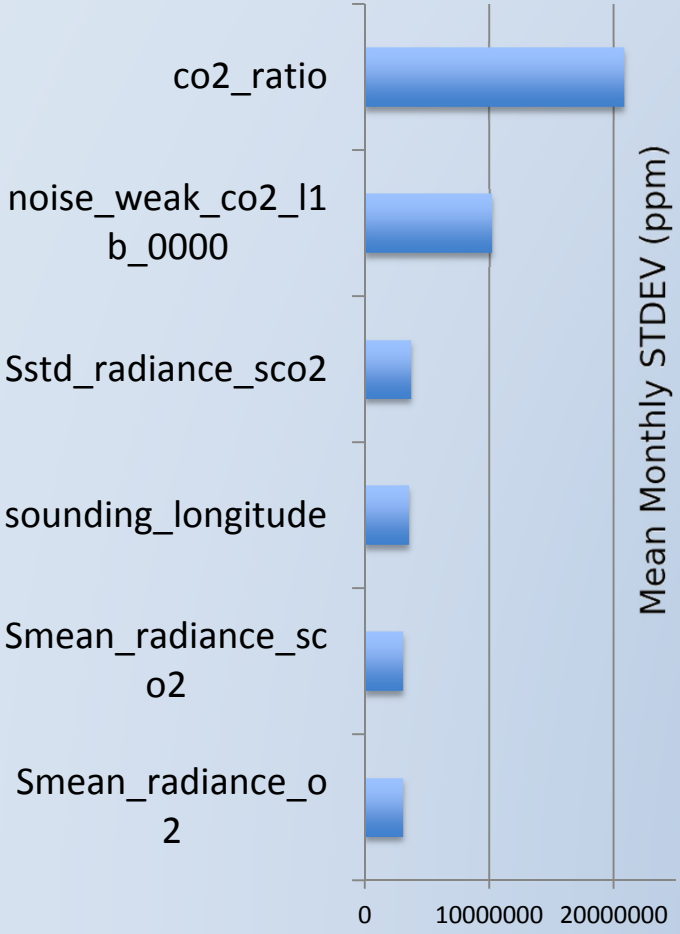
4) Computer Time

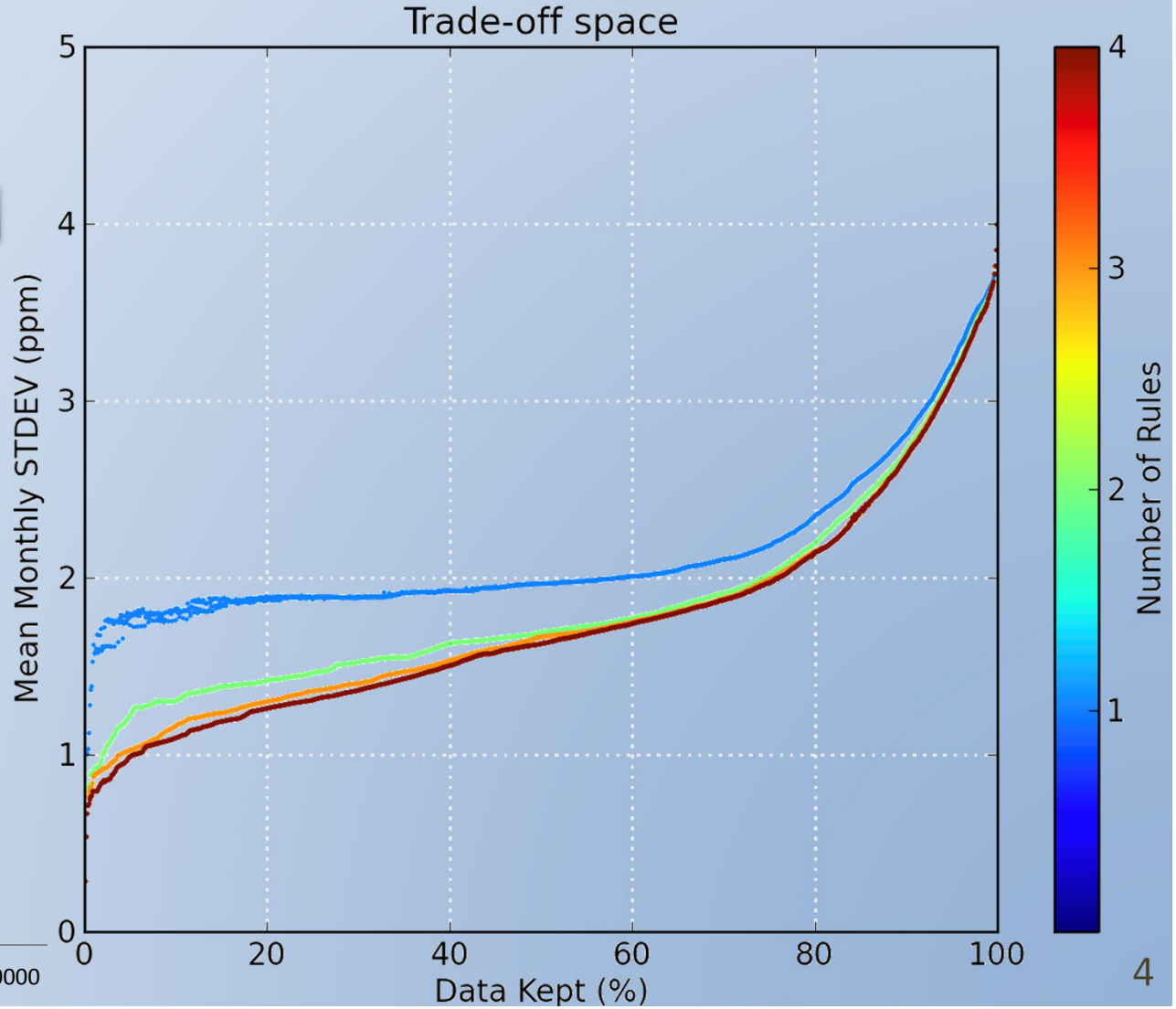
- About 1 night on the cluster

Scatter Correlators for LAND

Co2_ratio = Estimated CO2 Strong / Estimated CO2 Weak from Christian
Co2_ratio paired with either noise_WCO2 or S-polarization STDEV(radiance_SCO2)
Dominates over half of the graph. Land is always more complex.

>2 rules not really useful

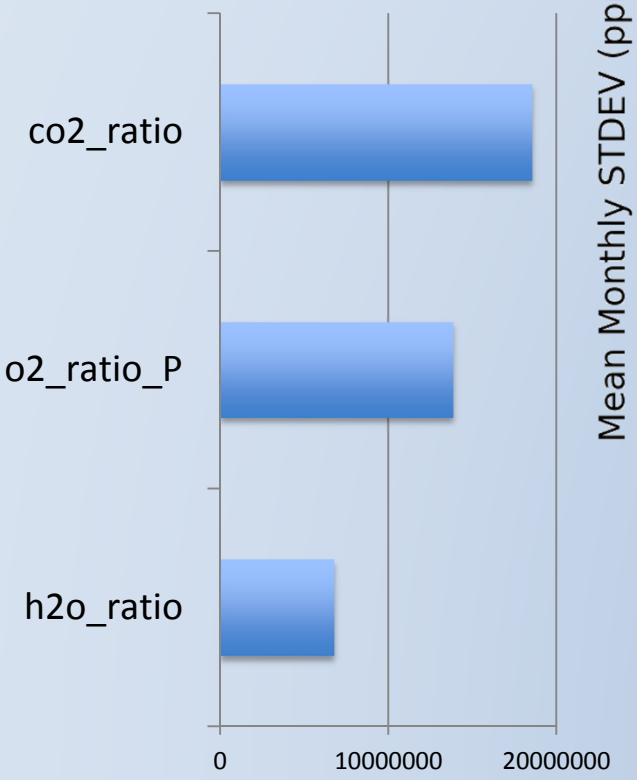


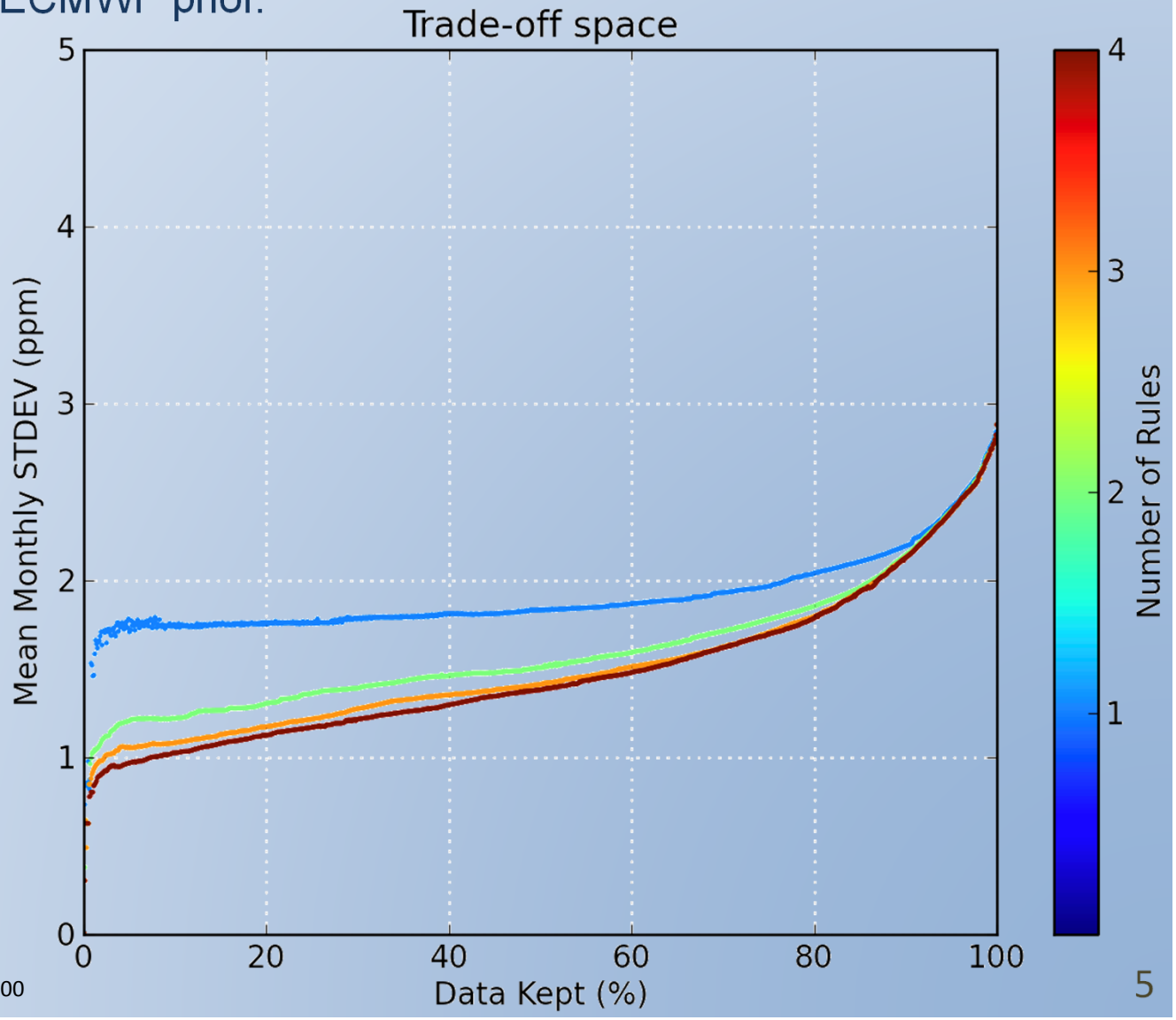


Scatter Correlators for GLINT

Co2_ratio now paired with o2_ratio_P or h2o_ratio dominates over 90% of the graph.
H2O ratio is also ratio of Strong/Weak estimates from Christian
O2_ratio is Estimated O2 / ECMWF prior.

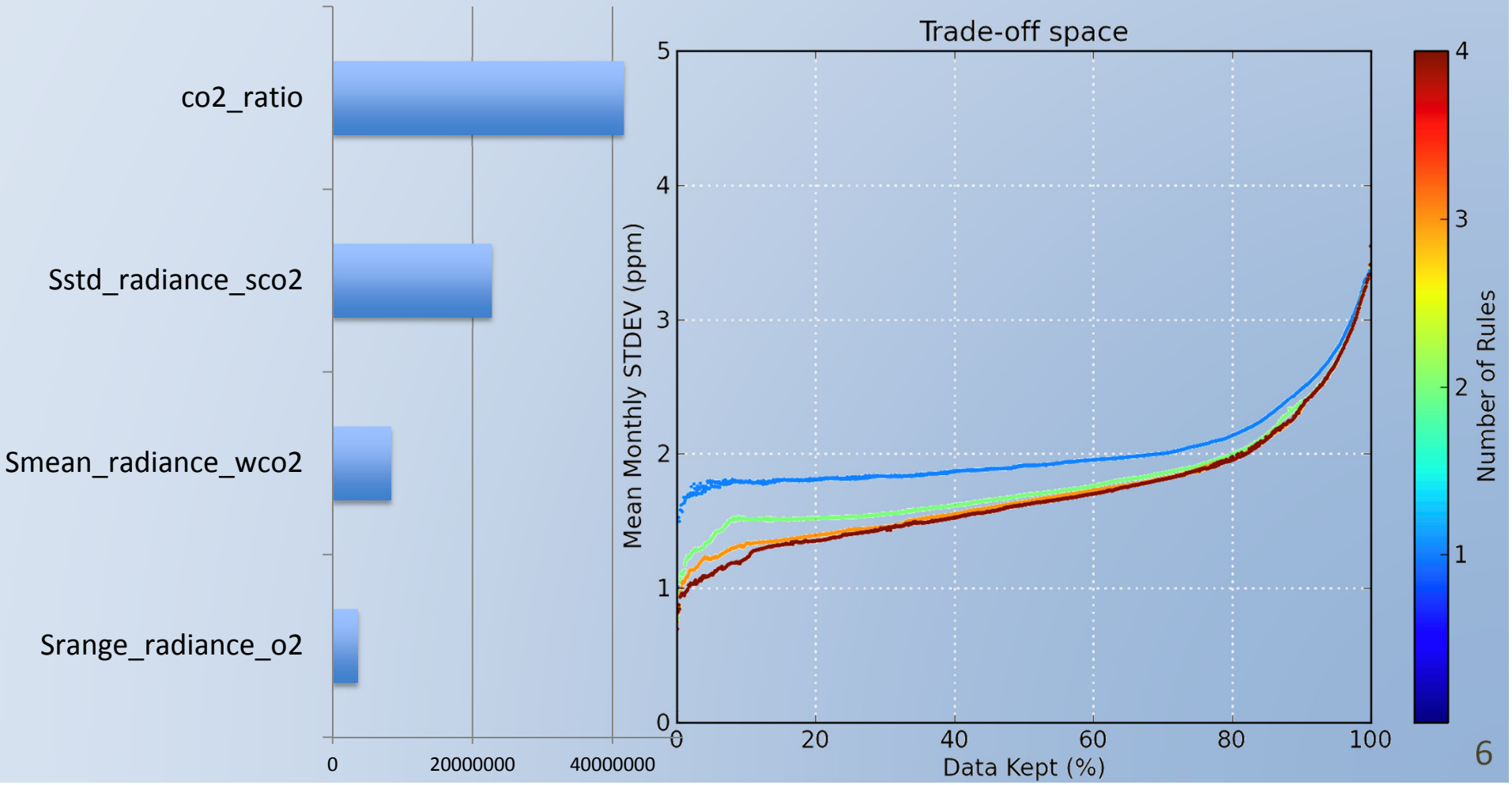
>2 rules not really useful





L1B Scatter Correlators for COMBINED

Co2_ratio (Christian's cloud filter) paired with S-polarization STDEV(radiance_SCO2)
Dominates over 80% of the 2-rule graph (teal color). Good performance.

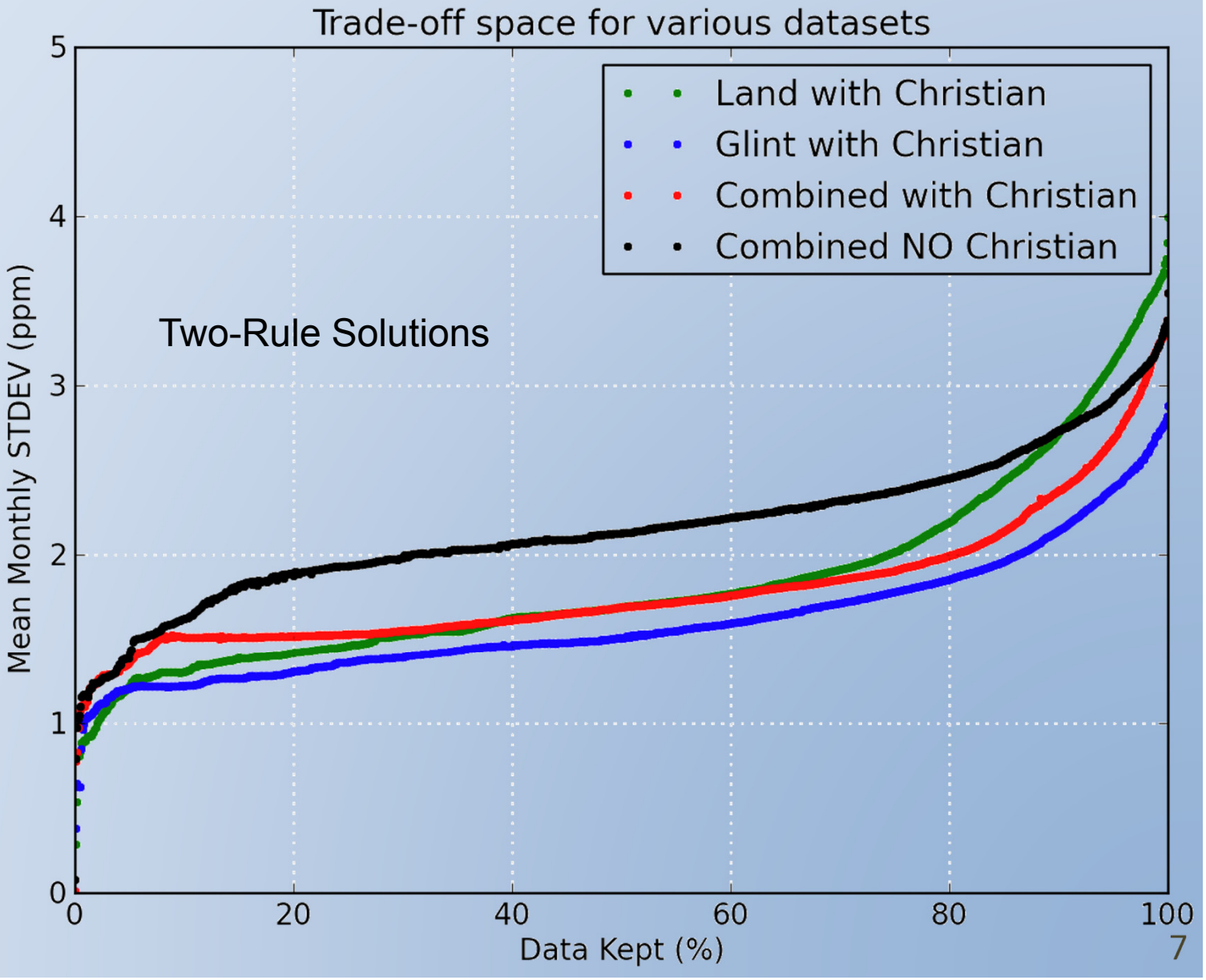


Should we bother with Christian's inputs?

Co2_ratio makes a huge difference.

Is itself as powerful as going from 1 rule to 2 rules.

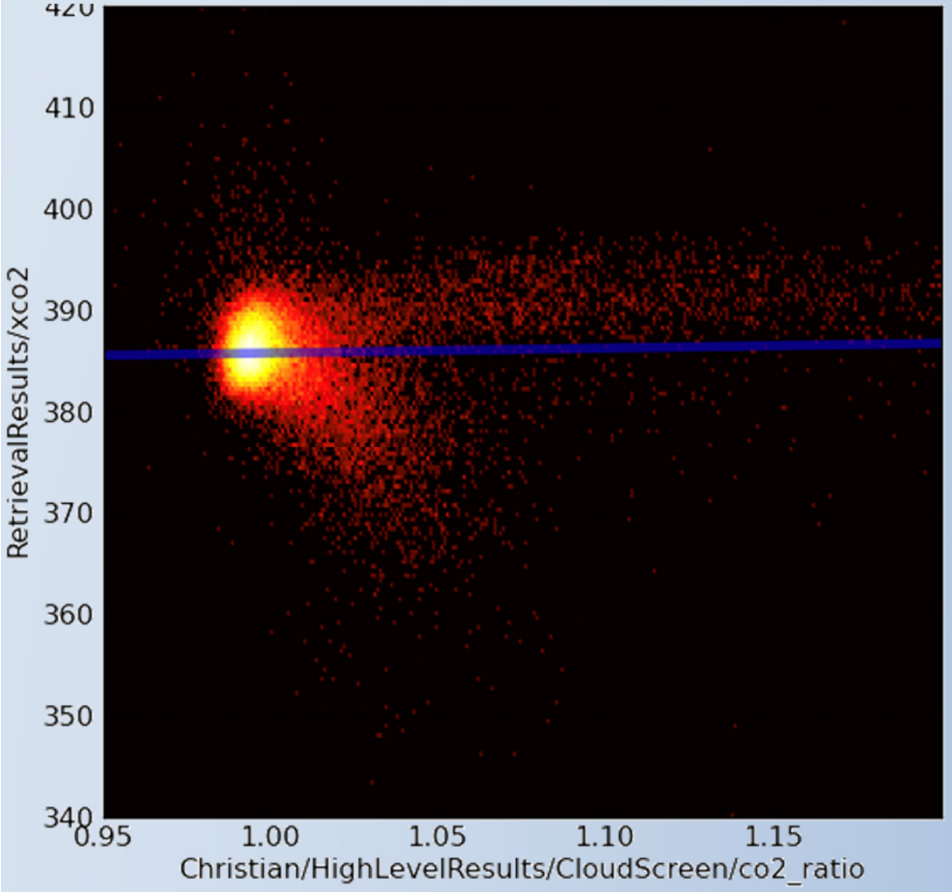
Without Christian's co2_ratio, dominant solutions center around Mean and Max radiances in SCO2 and O2



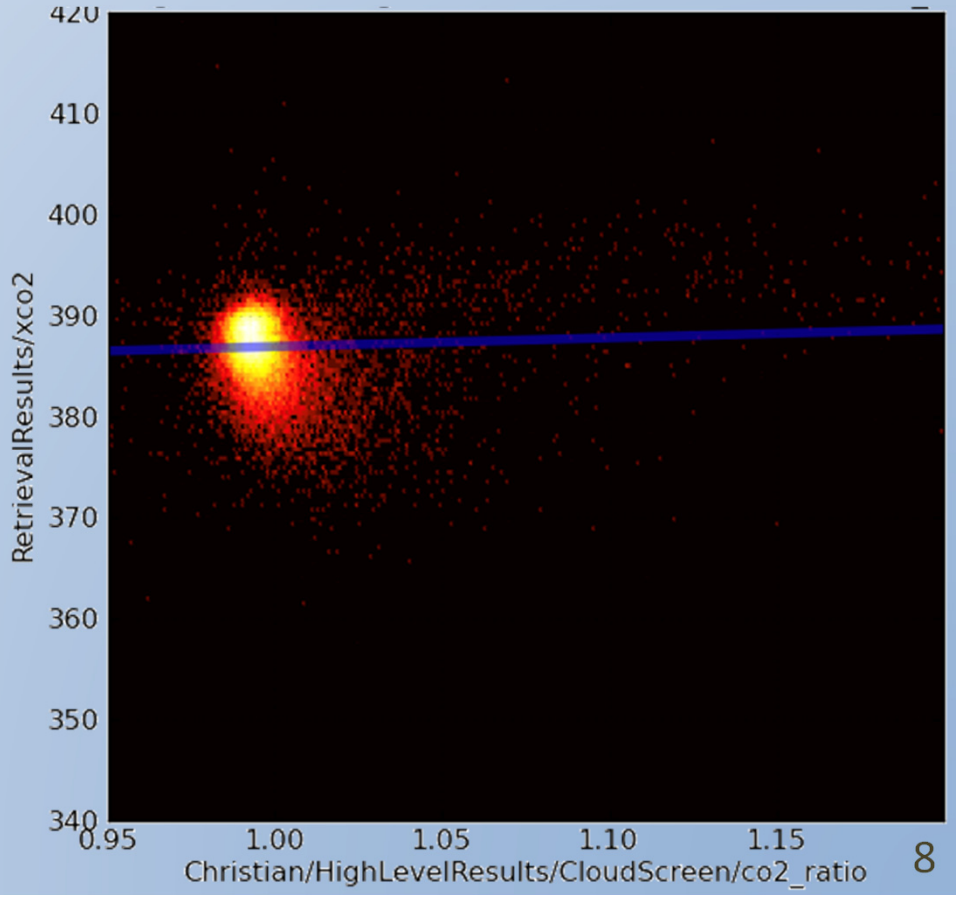
CO2_ratio

For Land & Glint, most values are at around 1.0.
Values > 1.02 have too high or two low XCO2, two populations
Fact that some processing is required for co2_ratio filters for some badness
Although populations are present, Glint is mostly going along for the ride here
Filter removes both too high and too low co2_ratio

Land

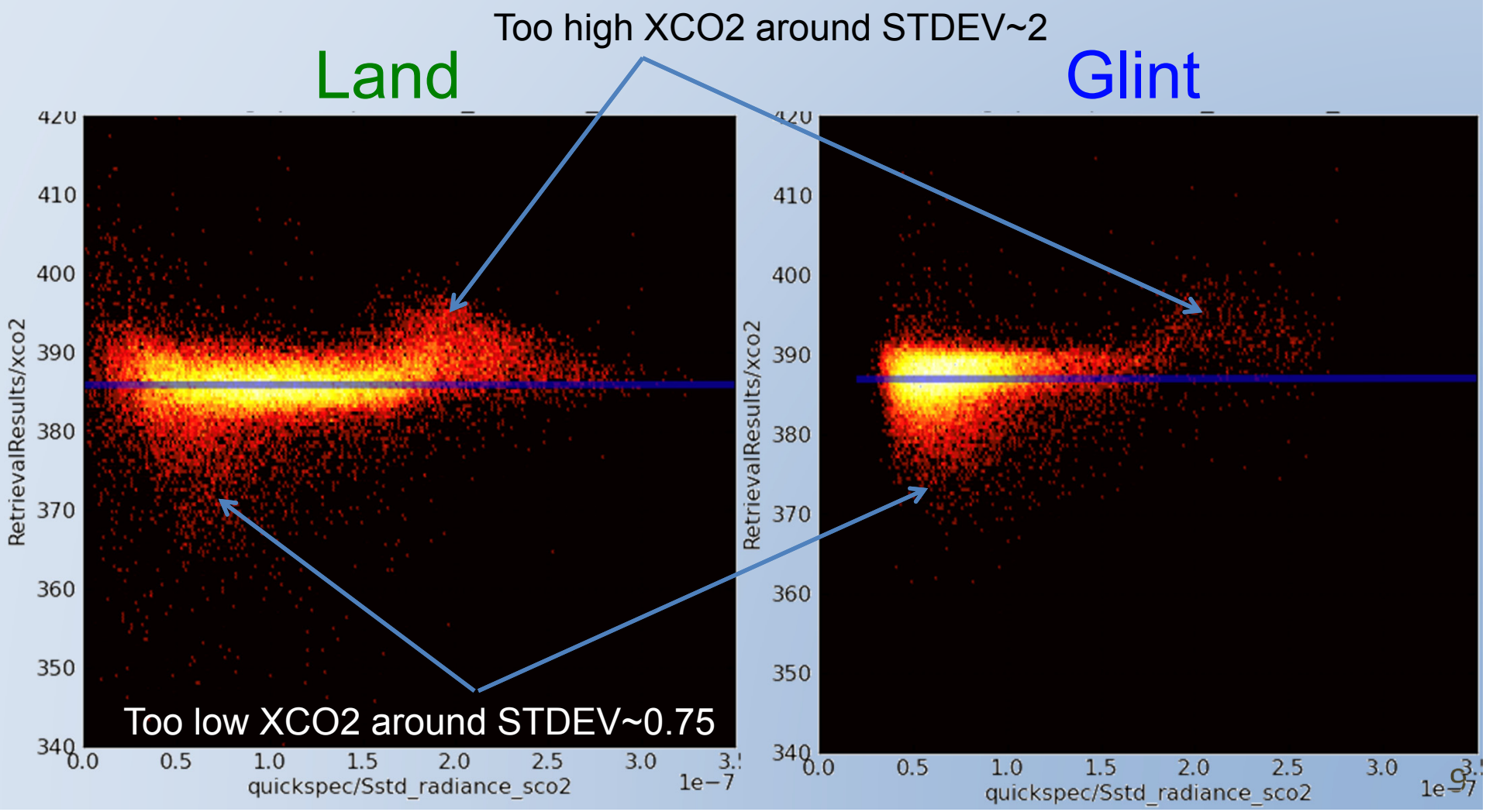


Glint



S-polarization STDEV Radiance SCO2

Multiple populations, large scatter at low STD(radiance_SCO2)
Filter sweeps in from left, killing everything to its left



Warn Level: A Measure of Data Quality

Each point on this trade-off graph is a filter

How to quickly estimate where a data sample would be filtered?

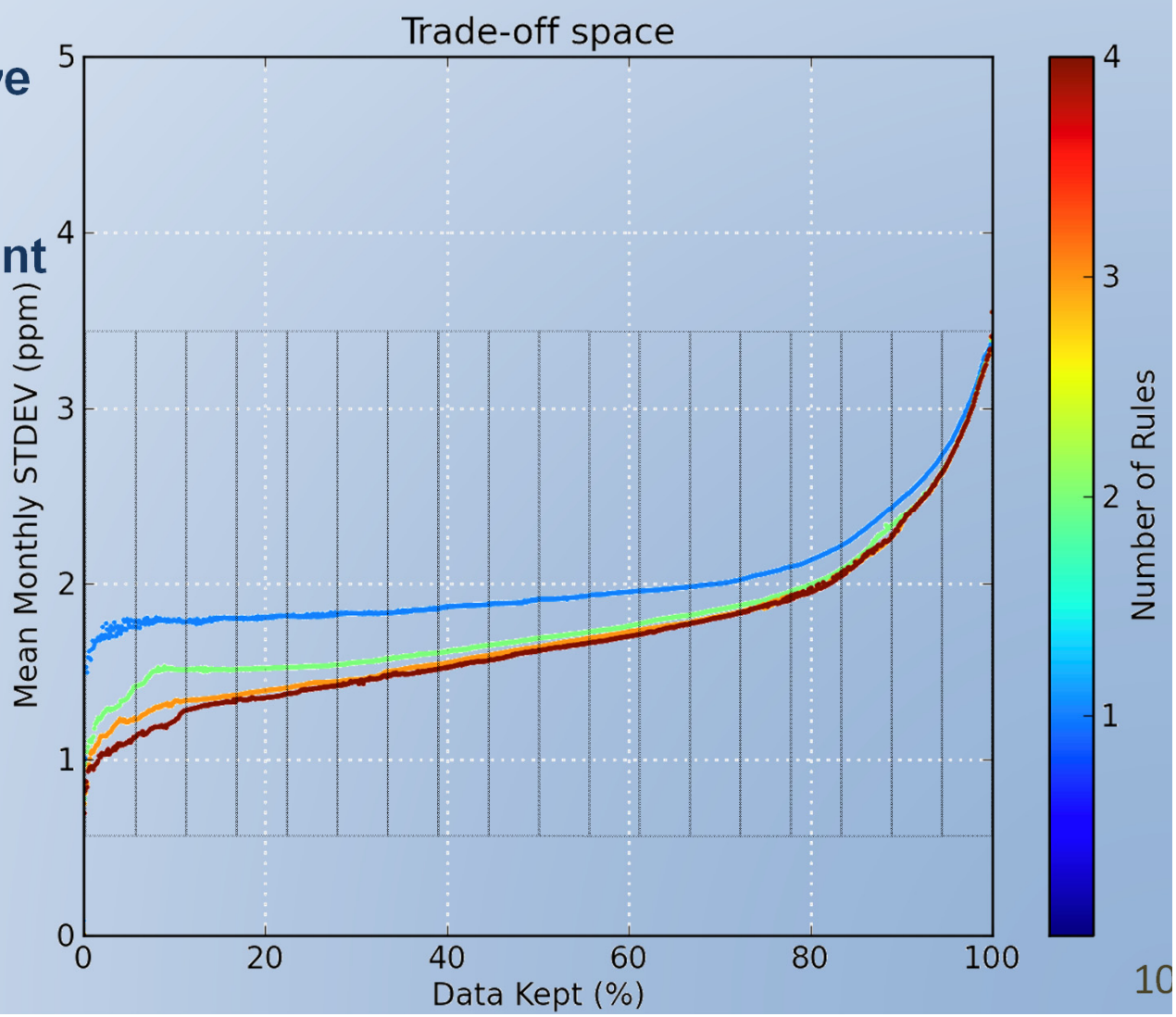
-Define 19 points on curve

-Count how many would reject a specific datapoint

-That's its "Warn Level"

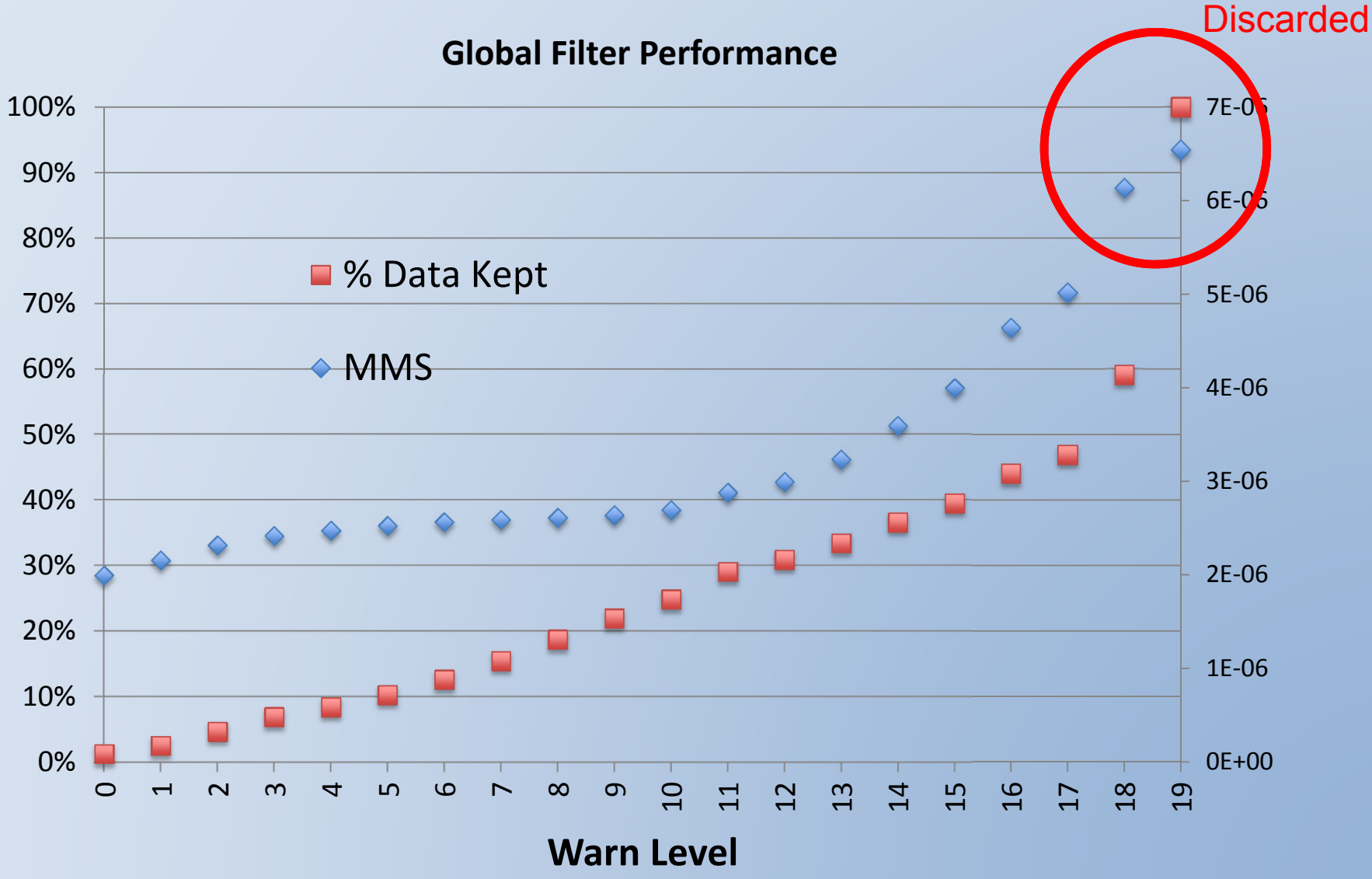
Ranges from 0-19

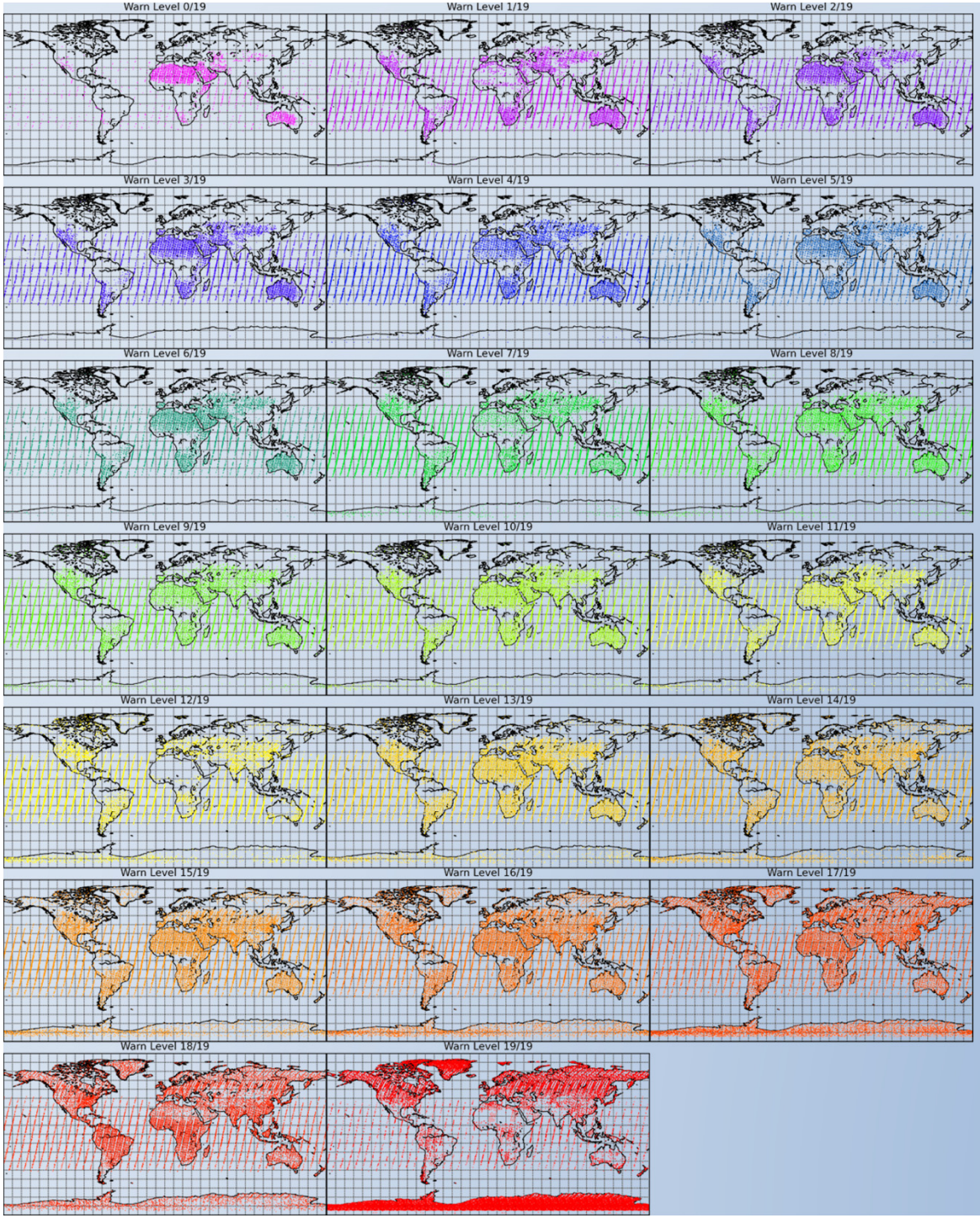
0 = universally accepted
19 = no one wants it



Global Stats … not the data trained on!

Monotonically decreases MMS scatter with lower warn level
Spans wide range of total data record (dynamic fidelity)





Application to Global L2 Dataset

1.1 M soundings

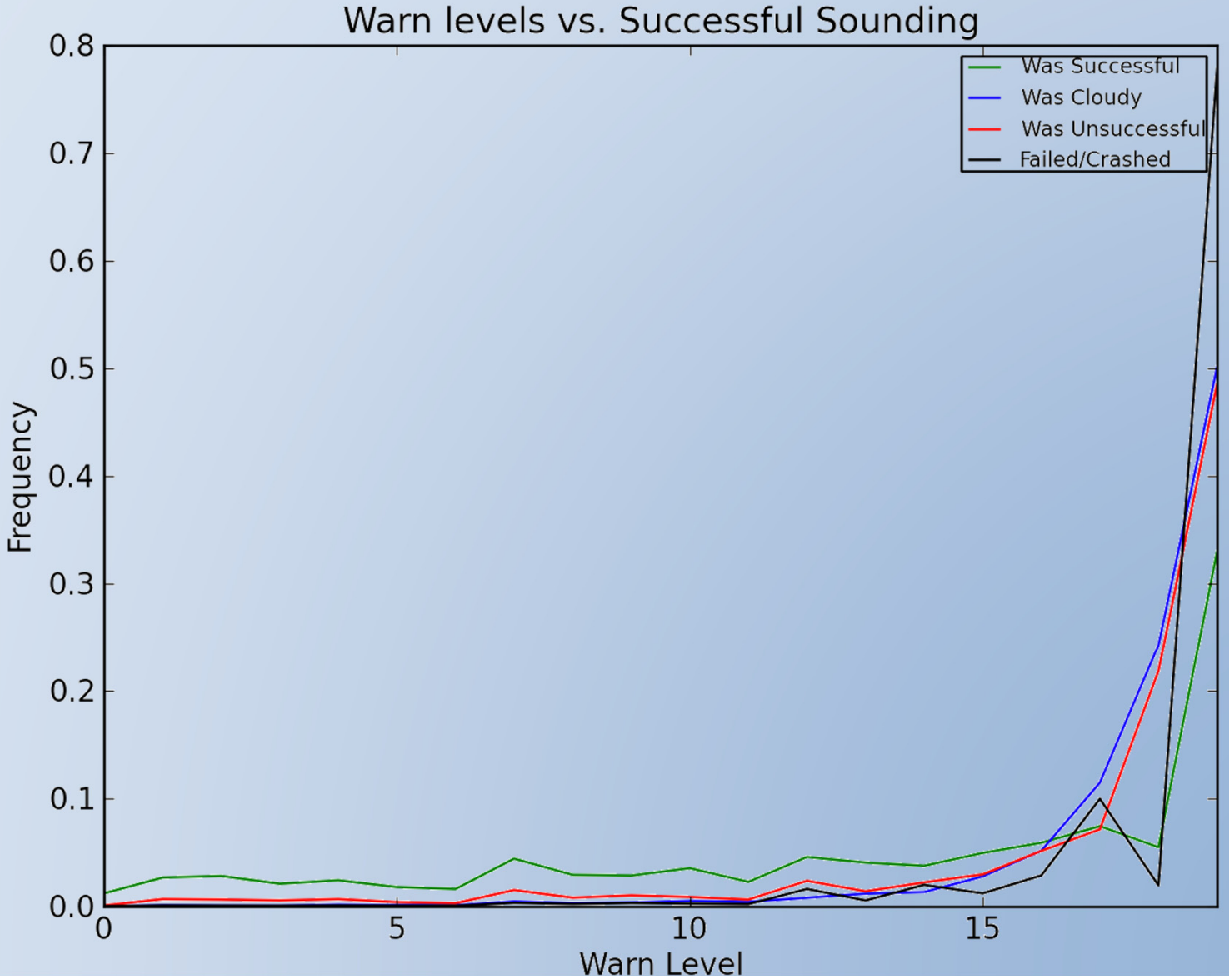
~40% of record warn level 19 (mostly over poles)

We discard WL 18 + 19 as unlikely to be helpful

Fairly uniform warn level coverage

L1B Sounding Destiny vs. Warn Level

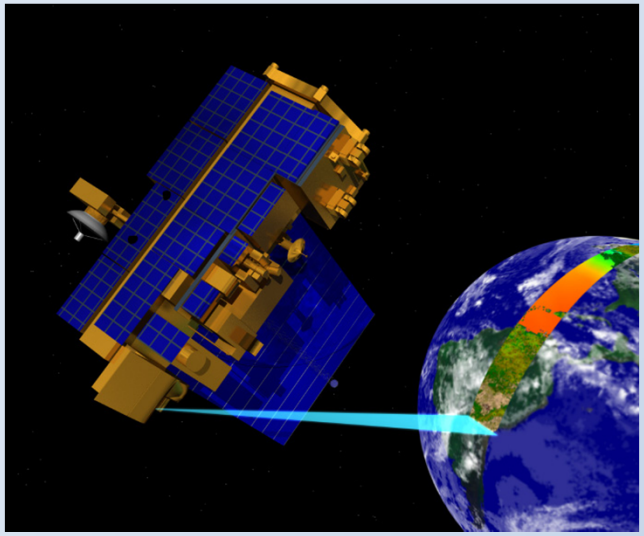
Cloudy, Failed Runs, and Poor Outcome Runs all correlate with Warn Level
All 6.5 Million L1B soundings included in this graph



Ensuring Global Coverage

(How do I use Warn Levels?)

Three Quotas for Soundings



Rule 1: Pick low Warn Levels first

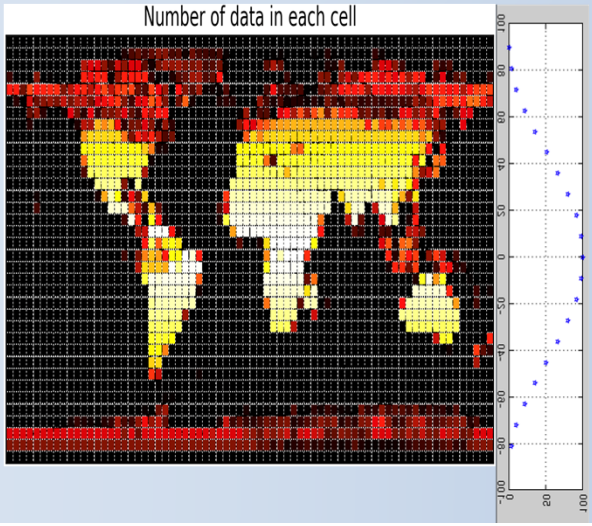
Designed to operate on whatever strip of soundings you have acquired thus far.

Target Mode switching breaks up observation run

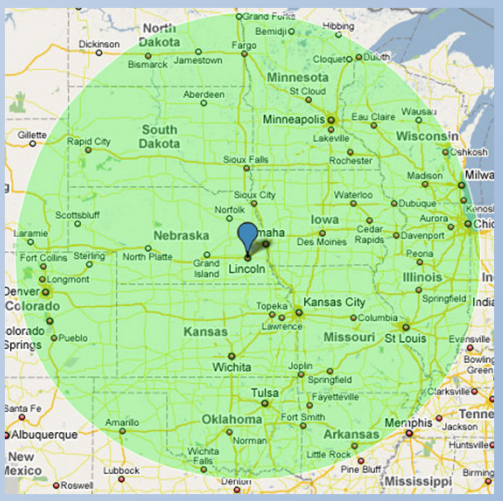
Some minor edge effects near switching events

Can always re-select later during reprocessing

Quota 1: Latitude-based Bins (M_B)



Quota 2: Flyby (N_S)

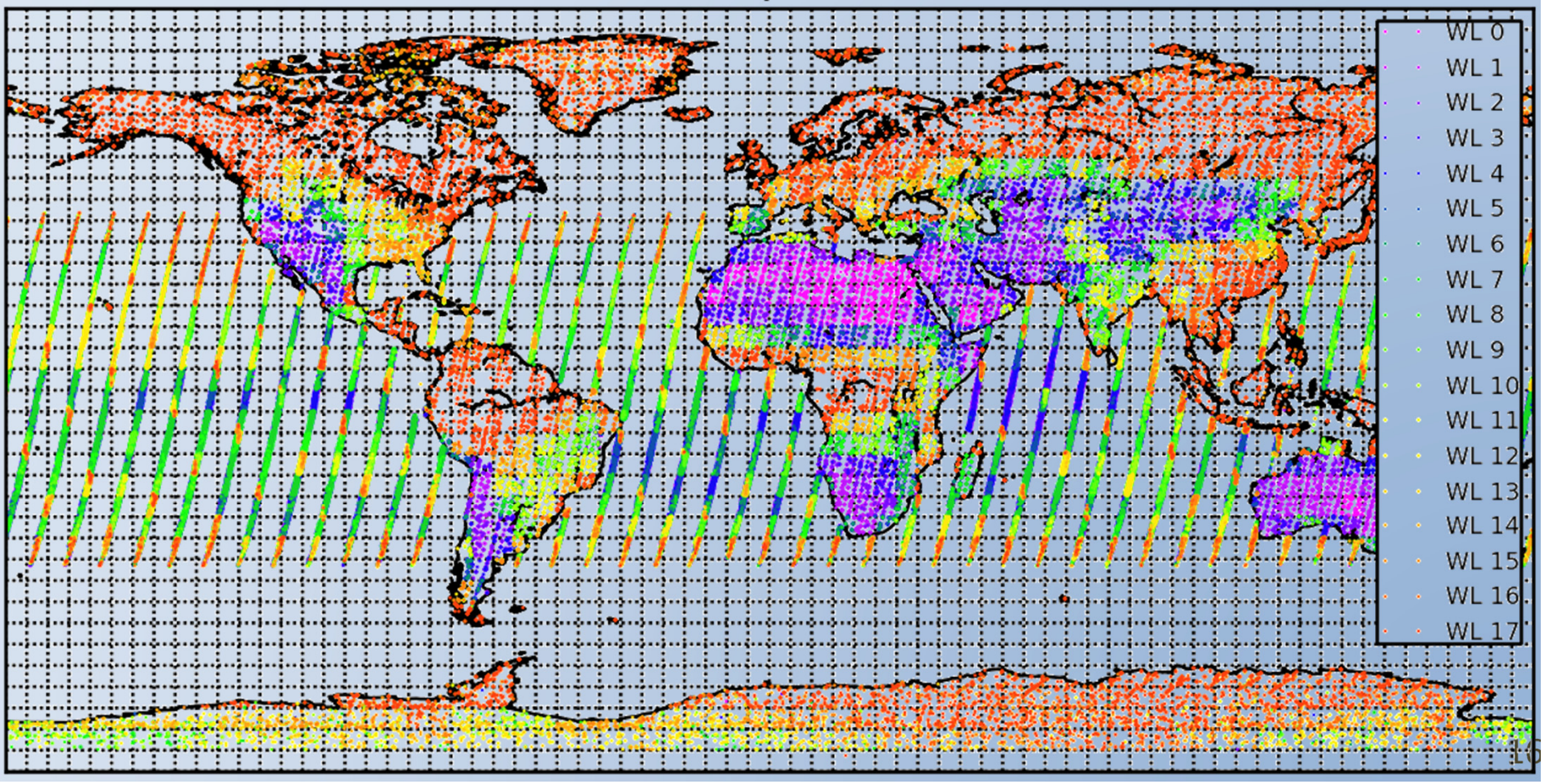


Quota 3: Global Percent

Global Coverage Results

Uniformly covers the globe, land and sea
Equatorial Land is sparse, much data is unreliable (tossed WL 18/19)
Glint has high warn levels near poles and lower near equator
Worst-selected WL dominates color

Warn levels vs. spatial distribution

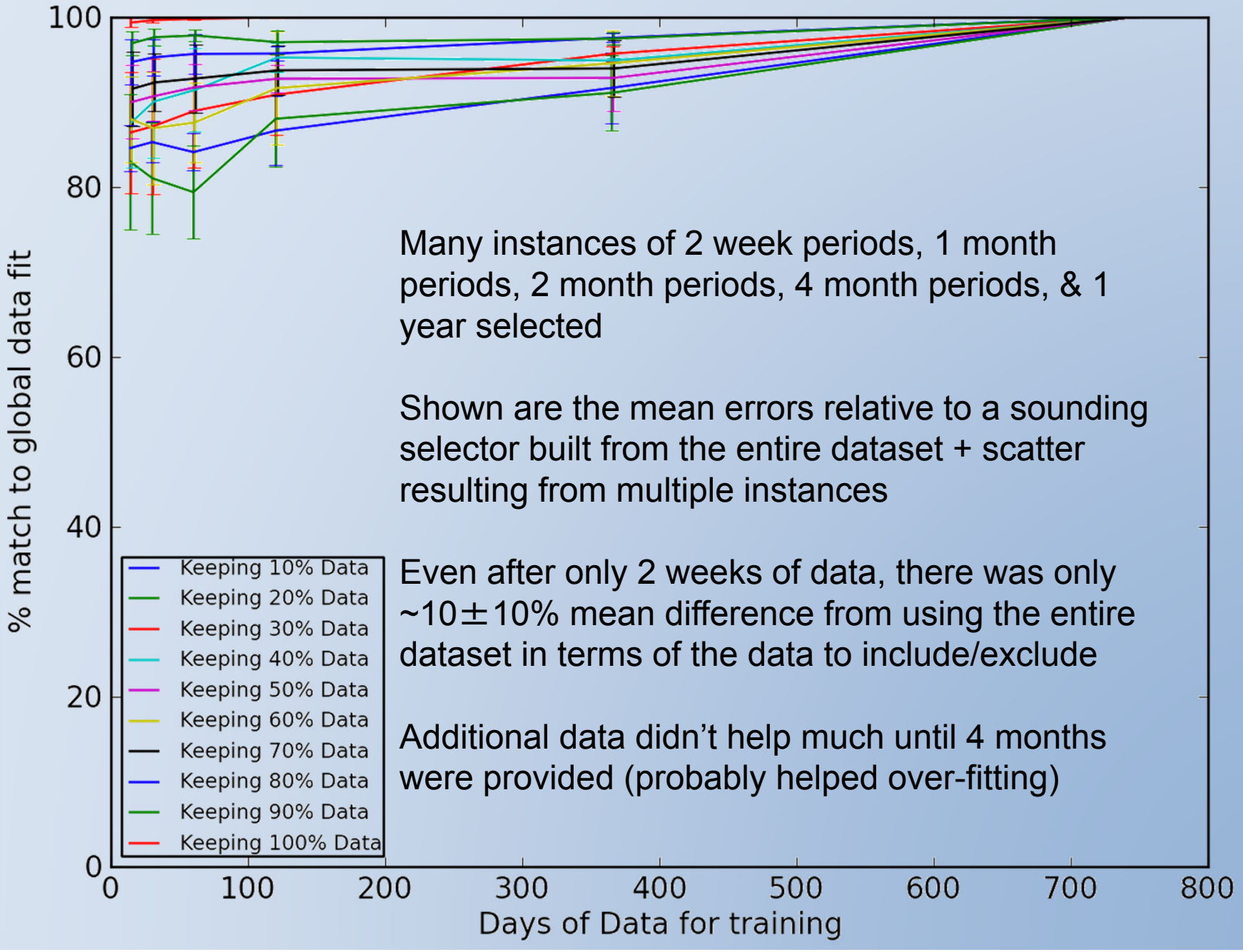


And management says…

Looks good!

How much data do you need?
(say, simulator perhaps?)

Thresholds Selected



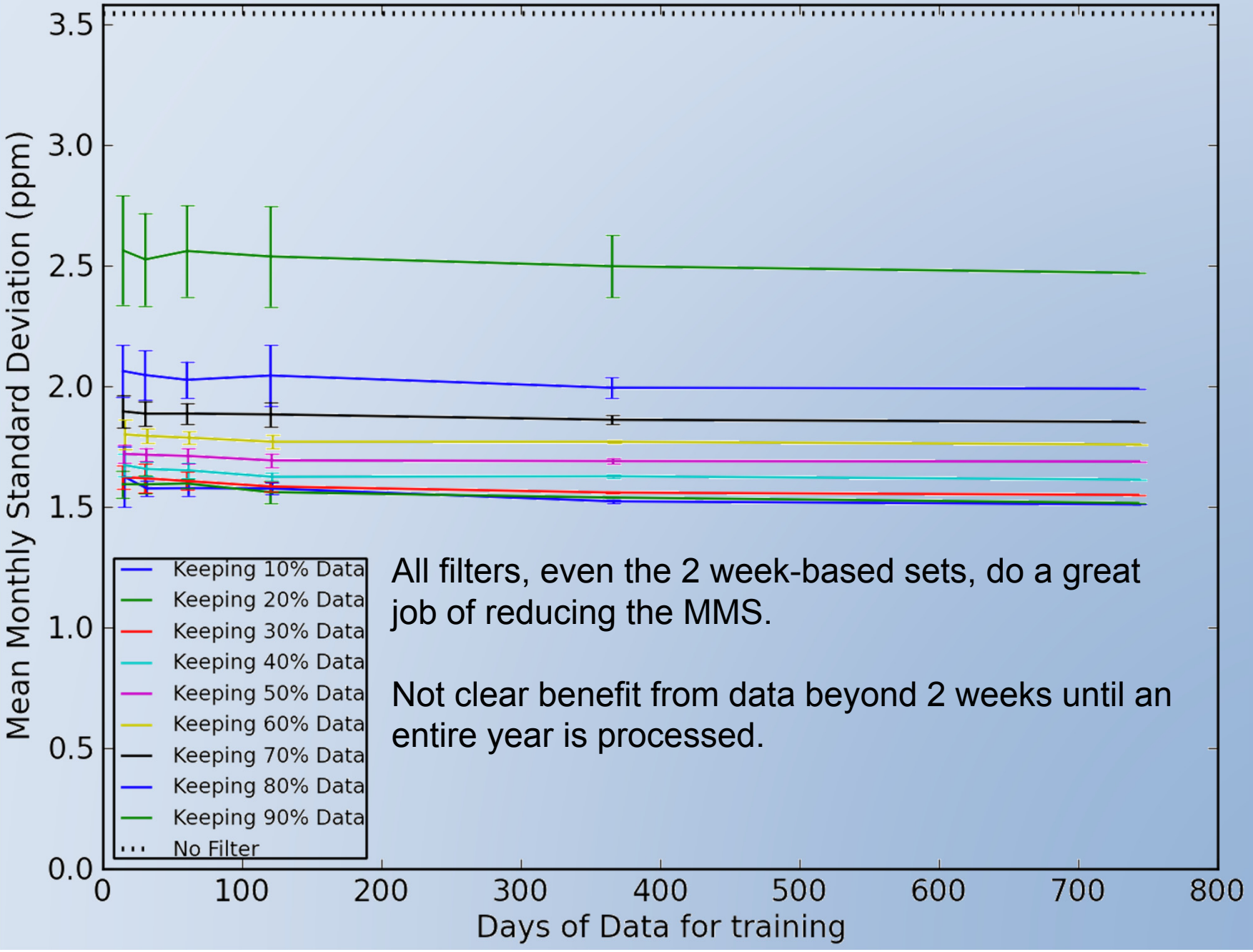
Many instances of 2 week periods, 1 month periods, 2 month periods, 4 month periods, & 1 year selected

Shown are the mean errors relative to a sounding selector built from the entire dataset + scatter resulting from multiple instances

Even after only 2 weeks of data, there was only ~10±10% mean difference from using the entire dataset in terms of the data to include/exclude

Additional data didn't help much until 4 months were provided (probably helped over-fitting)

Resulting MMS from 2-week filters



All filters, even the 2 week-based sets, do a great job of reducing the MMS.

Not clear benefit from data beyond 2 weeks until an entire year is processed.

Summary

Obtained method for building sounding selector

-Derived on 2.8 and 2.9 data yielding different sounding selectors
-Exercising on 2.10, will study results & generate new version

Christian's co2_ratio quick-look product is highly informative

-Provides additional level of quality check (must process OK)
-Cheat (not entirely L1B)

Warn Levels provide fast way to intelligently populate globe

-Correlate with clouds, bad CO2, and convergence failure
-Prefer areas known to retrieve well
-Couple with global quota system to dial-in coverage

Legal

- The research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.